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IBM Technical Disclosure Bulletins

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Search History

DATE: Monday, May 13, 2002 Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L22	l4 and l17	7	L22
L21	l4 and l14	5	L21
L20	l4 and l13	5	L20
L19	(((713/201)!.CCLS.))	976	L19
L18	(((713/188)!.CCLS.))	57	L18
L17	(((713/$)!.CCLS.))	10403	L17
L16	(((709/253)!.CCLS.))	136	L16
L15	(((709/200)!.CCLS.))	451	L15
L14	(((709/$)!.CCLS.))	15667	L14
L13	(((707/$)!.CCLS.))	13901	L13
L12	(((707/200)!.CCLS.))	857	L12
L11	(((707/104.1)!.CCLS.))	1669	L11
L10	(((707/100)!.CCLS.))	1013	L10
L9	(((707/10)!.CCLS.))	1993	L9
L8	((707/1)!.CCLS.)	1451	L8
L7	L6 and backup and restor$	4	L7
L6	second near transmit$ near (mechanism or device)	419	L6
L5	L4 and first same communication and second same communication	12	L5
L4	L2 and backup and restor$	24	L4
L3	L1 and "second communication"	8	L3
L2	L1 and "first computer"	79	L2
L1	"second computer" and backup and "data storage" and network	131	L1

END OF SEARCH HISTORY

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L5: Entry 7 of 12 File: USPT Dec 14, 1999

US-PAT-NO: 6003044
DOCUMENT-IDENTIFIER: US 6003044 A

TITLE: Method and apparatus for efficiently backing up files using multiple computer systems

DATE-ISSUED: December 14, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pongracz; Gregory	Redwood City	CA		
Wertheimer; Steven	Kentfield	CA		
Bridge; William	Alameda	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Oracle Corporation	Redwood Shores	CA			02

APPL-NO: 8/ 962086 [PALM]
DATE FILED: October 31, 1997

PARENT-CASE:
RELATED APPLICATIONS The subject matter of this application is related to the subject matter of attorney docket number 1027, application Ser. No. 08/962,539 entitled, "METHOD AND APPARATUS FOR RESTORING A PORTION OF A DATABASE" filed on Oct. 31, 1997 by C. Gregory Doherty, Gregory Pongracz, William Bridge, Juan Loaiza and Mark Ramacher, attorney docket number 1028, application Ser. No. 08/962,087 , entitled, "METHOD AND APPARATUS FOR IDENTIFYING FILES USED TO RESTORE A FILE" filed on Oct. 31, 1997 by Gregory Pongracz, Steven Wertheimer and William Bridge, attorney docket number 1036, application Ser. No. 08/961,747 entitled, "METHOD AND APPARATUS FOR PRESERVING NON-CURRENT INFORMATION THAT CAN BE OVERWRITTEN IN A COMPUTER FILE" filed on Oct. 31, 1997 by Gregory Pongracz and Tuomas Pystynen, attorney docket number 1038, application Ser. No. 08/961,741 entitled, "METHOD AND APPARATUS FOR ACCESSING A FILE THAT CAN BE CONCURRENTLY WRITTEN" filed on Oct. 31, 1997 by Tuomas Pystynen and Gregory Pongracz having the same assignee as this application and incorporated herein by reference in its entirety.

INT-CL: [6] G06 F 12/00

US-CL-ISSUED: 707/204; 711/162
US-CL-CURRENT: 707/204; 711/162

FIELD-OF-SEARCH: 707/204, 707/200, 707/208, 707/10, 395/826, 711/161, 711/162

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	5515502	May 1996	Wood	395/182.13
☐	5721916	February 1998	Pardikar	395/617
☐	5790886	August 1998	Allen	395/825
☐	5799322	August 1998	Mosher, Jr.	707/202
☐	5819296	October 1998	Anderson et al.	707/204
☐	5832522	November 1998	Blickenstaff et al.	707/204
☐	5857193	January 1999	Sutcliffe et al.	707/10
☐	5857208	January 1999	Ofek	707/204
☐	5860122	January 1999	Owada et al.	711/162

ART-UNIT: 277
PRIMARY-EXAMINER: Kulik; Paul V.
ATTY-AGENT-FIRM: Law Offices of Charles E. Gotlieb

ABSTRACT:

A system and method backs up computer files to backup drives connected to multiple computer systems. Each file in a backup set is allocated to one or more backup subsets for each of the multiple computer systems. The files can be allocated in an even number across each subset, allocated to evenly spread the number of bytes to each subset, or, using the capacity of each of the multiple computer systems, allocated so that each computer system can complete backing up the files allocated to it in approximately the same amount of time. The system can restrict the number of bytes continuously required from a single disk by one of the backup machines from exceeding a threshold limit. Each of the multiple computer systems is then directed to, and the computer systems do, back up files in one or more subsets, which may be allocated to that computer system.

17 Claims, 5 Drawing figures

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End of Result Set

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L5: Entry 12 of 12 File: USPT Nov 23, 1971

US-PAT-NO: 3623014
DOCUMENT-IDENTIFIER: US 3623014 A

TITLE: COMPUTER COMMUNICATIONS SYSTEM

DATE-ISSUED: November 23, 1971

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doelz; Melvin L.	Corona Del Mar	CA		
Martin; Robert F.	Orange	CA		
Morioka; Fred K.	Tustin	CA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Control Data Corporation	Santa Ana	CA			

APPL-NO: 4/ 852714 [PALM]
DATE FILED: August 25, 1969

INT-CL: [] G06f 15/16

US-CL-ISSUED: 340/172.5
US-CL-CURRENT: 714/6

FIELD-OF-SEARCH: 340/172.5, 235/157

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected | Search ALL

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	3312954	April 1967	Bible et al.	340/172.5
☐	3374465	March 1968	Richmond et al.	340/172.5
☐	3377623	April 1968	Reut et al.	340/172.5
☐	3409877	November 1968	Alterman et al.	340/172.5
☐	3411139	November 1968	Lynch et al.	340/172.5
☐	3444528	May 1969	Lovell et al.	340/172.5

ART-UNIT: 237
PRIMARY-EXAMINER: Shaw; Gareth D.
ASSISTANT-EXAMINER: Chapuran; Ronald F.
ATTY-AGENT-FIRM: Spensley, Horn and Lubitz

ABSTRACT:

A computer controlled, data communications system is provided for transmitting data between a plurality of external devices. The system comprises up to eight, general purpose, digital computers, each with an associated disc-file storage system. The computers and the disc-file storage units are organized such that communication between the computers is made via the disc-file storage associated with each computer, not directly between the computers themselves. Each group of external devices is coupled to a primary and secondary computer such that upon the failure of the primary computer, the secondary computer will procss the data for its primary group of devices as well as for those external devices for which it is the secondary computer. Each disc-file storage unit is the primary storage for one computer and the copy storage for one additional computer. Upon the failure of a primary disc-file storage unit, a computer can operate with the copy storage unit.

7 Claims, 7 Drawing figures

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L15	L13 and port!	6	L15
L14	L13 and socket	6	L14
L13	L12 and database same application	24	L13
L12	l8 and network and restor$	95	L12
L11	L10 and port!	11	L11
L10	L8 and socket	14	L10
L9	L8 and network near storage	1	L9
L8	L7 and backup and restore	107	L8
L7	first near computer and second near computer	5889	L7
L6	L5 and backup and restore	4	L6
L5	l4 and first near computer and second near computer	11	L5
L4	5206939.uref.	93	L4
DB=USPT; PLUR=YES; OP=OR			
L3	4862411.pn.	1	L3
L2	4939598.pn.	1	L2
DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=OR			
L1	5206939.pn.	3	L1

END OF SEARCH HISTORY

PALM INTRANET

Day : Monday
Date: 5/13/2002
Time: 07:14:35

Patent Number Information

Application Number: **07/586796**
Assignments
Filing Date: **09/24/1990**
Effective Date: **09/24/1990**
Application Received: **09/24/1990**
Patent Number: **5206939**
Issue Date: **04/27/1993**
Date of Abandonment: **00/00/0000**
Attorney Docket Number: **EMC-103XX**
Status: **150 / PATENTED CASE**
Confirmation Number: **3295**

Examiner Number: **68908 / BOWLER, ALYSSA**
Group Art Unit: **2312**
Class/Subclass: **395/400.000**
Lost Case: **NO**
Interference Number:
Unmatched Petition:
L&R Code: Secrecy Code:**1**
Third Level Review: **NO**
Secrecy Order: **NO**
Status Date: **04/15/1993**

Title of Invention: **SYSTEM AND METHOD FOR DISK MAPPING AND DATA RETRIEVAL**

Bar Code #	Location	Location Date	Chrg to Location	Charge to Name	Emp. ID	Infra Loc
07586796	9210 RECORD ROOM 308-2733	05/07/2002			DWYATT	

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Day : Monday
Date: 5/13/2002
Time: 07:12:56

Application Number Information

Application Number: **09/894422**
Assignments
Filing Date: **06/28/2001**
Effective Date: **06/28/2001**
Application Received: **06/29/2001**
Patent Number:
Issue Date: **00/00/0000**
Date of Abandonment: **00/00/0000**
Attorney Docket Number: **EMC-00-067**
Status: **30 /DOCKETED NEW CASE - READY FOR EXAMINATION**
Confirmation Number: **6882**

Examiner Number: **71586 / RINEHART, MARK**
Group Art Unit: **2152**
Class/Subclass: **709/225.000**
Lost Case: **NO**
Interference Number:
Unmatched Petition: **NO**
L&R Code: Secrecy Code:**1**
Third Level Review: **NO**
Secrecy Order: **NO**
Status Date: **10/15/2001**

Title of Invention: **SYSTEM AND METHOD FOR MANAGING REPLICATION SETS OF DATA DISTRIBUTED OVER ONE OR MORE COMPUTER SYSTEMS**

Bar Code	Location	Location Date	Chrg to Loc	Charge to Name	Emp. ID	Infra Loc
09894422	2FC1 REPOSITORY CENTRAL FILES OVERFLOW FOR TC'S 1700, 2100, 2600 & 2800	03/20/2002		No Charge to Name	DWENDEMAGEGEH	FRAN/01/

Appln Info | Contents | Petition Info | Atty/Agent Info | Continuity Data | Foreign Data | Inve

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PALM INTRANET

Day : Monday
Date: 5/13/2002
Time: 07:13:14

Application Number Information

Application Number: **09/946007**
Assignments
Filing Date: **09/04/2001**
Effective Date: **09/04/2001**
Application Received: **09/05/2001**
Patent Number:
Issue Date: **00/00/0000**
Date of Abandonment: **00/00/0000**
Attorney Docket Number: **EMC-008PUS**
Status: **30 /DOCKETED NEW CASE - READY FOR EXAMINATION**
Confirmation Number: **5827**

Examiner Number: **71586 / RINEHART, MARK**
Group Art Unit: **2152**
Class/Subclass: **709/225.000**
Lost Case: **NO**
Interference Number:
Unmatched Petition: **NO**
L&R Code: Secrecy Code:**1**
Third Level Review: **NO**
Secrecy Order: **NO**
Status Date: **03/24/2002**

Title of Invention: **INFORMATION REPLICATION SYSTEM MOUNTING PARTIAL DATABASE REPLICATIONS**

Bar Code	Location	Location Date	Chrg to Loc	Charge to Name	Emp. ID	Infra Loc
09946007	2FC1 REPOSITORY CENTRAL FILES OVERFLOW FOR TC'S 1700, 2100, 2600 & 2800	03/28/2002		No Charge to Name	DWENDEMAGEGEH	FRAN/01/

Appln Info | Contents | Petition Info | Atty/Agent Info | Continuity Data | Foreign Data | Inve

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Day : Monday
Date: 5/13/2002
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Application Number Information

Application Number: **09/946078**
Assignments
Examiner Number: **71586 / RINEHART, MARK**
Filing Date: **09/04/2001**
Group Art Unit: **2152**
Effective Date: **09/04/2001**
Class/Subclass: **709/225.000**
Application Received: **09/05/2001**
Lost Case: **NO**
Patent Number:
Interference Number:
Issue Date: **00/00/0000**
Unmatched Petition: **NO**
Date of Abandonment: **00/00/0000**
L&R Code: Secrecy Code:**1**
Attorney Docket Number: **EMC-007PUS**
Third Level Review: **NO**
Secrecy Order: **NO**
Status: **30 /DOCKETED NEW CASE - READY FOR EXAMINATION**
Status Date: **03/13/2002**
Confirmation Number: **4568**
Title of Invention: **INFORMATION REPLICATION SYSTEM HAVING ENHANCED ERROR DETECTION AND RECOVERY**

Bar Code	Location	Location Date	Chrg to Loc	Charge to Name	Emp. ID	Infra Loc
09946078	2FC1 REPOSITORY CENTRAL FILES OVERFLOW FOR TC'S 1700, 2100, 2600 & 2800	04/02/2002		No Charge to Name	DWENDEMAGEGEH	FRAN/01/

Appln Info | Contents | Petition Info | Atty/Agent Info | Continuity Data | Foreign Data | Inve

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PALM INTRANET

Day : Monday
Date: 5/13/2002
Time: 07:16:27

Application Number Information

Application Number: **09/000540**
Assignments
Filing Date: **12/30/1997**
Effective Date: **12/30/1997**
Application Received: **12/30/1997**
Patent Number:
Issue Date: **00/00/0000**
Date of Abandonment: **00/00/0000**
Attorney Docket Number: **EMC97029**
Status: **83 /ADVISORY ACTION MAILED**
Confirmation Number: **5453**

Examiner Number: **76701 / PHAM, BRENDA**
Group Art Unit: **2664**
Class/Subclass: **370/381.000**
Lost Case: **NO**
Interference Number:
Unmatched Petition: **NO**
L&R Code: Secrecy Code:**1**
Third Level Review: **NO**

Waiting for Response Desc.
Mail Final Rej.

Secrecy Order: **NO**
Status Date: **02/12/2001**

Title of Invention: **METHOD AND APPARATUS FOR TRANSFERS EMPLOYED IN DATA STORAGE SYSTEM**

Bar Code	Location	Location Date	Chrg to Loc	Charge to Name	Emp. ID	Infra Loc
09000540	26C1 TC 2600 CENTRAL FILES C1	11/07/2001		No Charge to Name	LOE CONV DR1995U	

Appln Info | Contents | Petition Info | Atty/Agent Info | Continuity Data | Foreign Data | Inve

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L1: Entry 1 of 3 File: USPT Apr 27, 1993

US-PAT-NO: 5206939
DOCUMENT-IDENTIFIER: US 5206939 A

TITLE: System and method for disk mapping and data retrieval

DATE-ISSUED: April 27, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yanai; Moshe	Framingham	MA		
Vishlitzky; Natan	Brookline	MA		
Alterescu; Bruno	Newton	MA		
Castel; Daniel	Farmingham	MA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
EMC Corporation	Hopkinton	MA			02

APPL-NO: 7/ 586796 [PALM]
DATE FILED: September 24, 1990

INT-CL: [5] G06F 13/00, G06F 12/06, G11B 5/09

US-CL-ISSUED: 395/400; 395/425, 364/DIG.1, 360/48
US-CL-CURRENT: 711/4; 360/48, 711/113, 711/206

FIELD-OF-SEARCH: 395/425, 395/595, 395/400, 360/48, 364/DIG.1, 364/252.3, 364/252.4, 364/255.2

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected | Search ALL

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4262332	April 1981	Bass et al.	364/200
☐	4310883	January 1982	Clifton et al.	364/200
☐	4500954	February 1985	Duke et al.	364/200
☐	4533955	August 1985	Christian et al.	364/200
☐	4533996	August 1985	Hartung et al.	364/200
☐	4862411	August 1989	Dishon et al.	364/952
☐	4939598	July 1990	Kulakowski et al.	360/48

ART-UNIT: 232

PRIMARY-EXAMINER: Bowler; Alyssa H.

ATTY-AGENT-FIRM: Weingarten, Schurgin, Gagnebin & Hayes

ABSTRACT:

An apparatus and method for disk mapping and data retrieval includes a data storage medium on which has been stored a plurality of data records. Each record includes at least a record identification portion, for uniquely identifying each record from among the plurality of data records. The apparatus builds a record locator table and high speed semiconductor memory which comprises the unique record identifiers for the records on the storage medium as well as a record locator index generated by the apparatus, which indicates the address of the data record on the storage medium. Data retrieval is facilitated by first searching the record locator table in high speed semiconductor memory for a requested data record. Utilizing the record locator index associated with the reqested data record, the system directly accesses the requested data record on the storage medium thereby minimizing storage medium search time. Also disclosed is an apparatus and method for converting CKD formatted data records to FBA formatted disk drives and for building and compressing the "count" portion of the CKD data formatted record into a record locator table.

19 Claims, 7 Drawing figures
Exemplary Claim Number: 1
Number of Drawing Sheets: 6

BRIEF SUMMARY:

FIELD OF THE INVENTION

This invention relates to data storage on disk drives and more particularly, to a method and apparatus for retrieving data records stored on a storage medium utilizing a data record locator index stored in memory.

BACKGROUND OF THE INVENTION

Large disk storage systems like the 3380 and 3390 direct access storage devices (DASD) systems employed with many IBM mainframe computer systems are implemented utilizing many disk drives. These disk drives are specially made to implement a count, key, and data (CKD) record format on the disk drives. Disk drives utilizing the CKD format have a special "address mark" on each track signifying the beginning of a record on the track. After the address mark comes the three part record beginning with the "COUNT" which serves as the record ID and also indicates the lengths of both the optional key and the data portions of the record, followed by the optional "KEY" portion, which in turn is followed by the "DATA" portion of the record.

Although this format gives the system and user some flexibility and freedom in the usage of the disk drive, this flexibility forces the user to use more complicated computer programs for handling and searching data on the disk. Since the disk drive track has no physical position indicator, the disk drive controller has no idea of the data which is positioned under the read/write head at any given instant in time. Thus, before data can be read from or written to the disk drive, a search for the record must be performed by sequentially reading all the record ID's contained in the count field of all the records on a track until a match is found. In such a search, each record is sequentially searched until a matching ID is found. Even if cache memory is used, all the records to be searched must first be read into the cache before being searched. Since searching for the record takes much longer than actual data transfer, the disk storage system spends a tremendous amount of time searching for data which drastically reduces system performance.

Disk drives employing what is known as a Fixed Block Architecture (FBA) are widely available in small, high capacity packages. These drives, by virtue of, their architecture, tend to be of higher performance than drives employing a CKD format. Such FBA drives are available, for example, from Fujitsu as 5.25" drives with 1 gigabyte or greater capacity.

The distinct advantage of utilizing many small disk drives is the ability to form a disk array. Thus a large storage capacity can be provided in a reduced amount of space, and storage redundancy can be provided in a cost effective manner. A serious problem arises, however, when trying to do a "simple" conversion of data from CKD formatted disks to FBA disks. Two schemes for such a conversion have been considered

which do not provide an acceptable solution to the conversion problem. The first of such schemes involves placing every field i.e. Count, Key and Data, of the CKD formatted record into a separate block on the FBA disk drive. Although this scheme does not waste valuable disk space when CKD formatted records contain large amounts of data, the "Count" field which is very short (8 bytes) occupies an entire block which is typically at least 512 bytes. For example, a CKD formatted record containing 47K bytes of data could be converted to 95 blocks of FBA disk, 512 bytes in length. In such a conversion, one block would be used to store the count of the record while 94 blocks (47K bytes length of data divided 512 bytes of FBA disk block) would be used to store data, for a total of 95 blocks. However, search time for finding the desired record is still a problem since all the records must be sequentially searched.

For records having very short data lengths such as eight bytes, however, one full track, or 94 CKD formatted data records would need 188 blocks on the FBA disk: 94 blocks for the count portion of the records and 94 blocks for the data portion of the records, even though each data record may only occupy 8 bytes of a 512 byte FBA block. Such a scheme may thus waste nearly 50% of the disk space on an FBA disk drive.

The second scheme for converting data from CKD to FBA drives involves starting each CKD record in a separate block and then writing the complete record in sequential blocks. Utilizing such a scheme, the first FBA block will contain the "count" portion of the record as well as the optional key portion and the start of the data portion of the record. This scheme, however, produces serious system performance degregation when data must be written to the disk, since before writing data to the disk, the entire record must first be read into memory, modified, and subsequently written back to the disk drive. Such a loss in system performance is generally unacceptable.

SUMMARY OF THE INVENTION

This invention features an apparatus and method for retrieving one or more requested data records stored on a storage medium by searching for a data record identifier and associated data record locator index stored in high speed semiconductor memory. The apparatus receives one or more data records, each of the data records including at least a record identification portion and a data portion. The apparatus transfers and stores the data records to one or more data storage mediums. As the records are transfered to the data storage medium, the apparatus of the present invention generates a plurality of record locator indices, each of the record locator indices corresponding to one of the plurality of data records, for uniquely identifying the location of each of the data records stored on the storage medium.

The apparatus further includes high speed semiconductor memory for storing at least the plurality of record locator indices and the associated plurality of record identification portions. Upon receiving a request for one or more data records stored on the storage mediums, the apparatus of the present invention searches the high speed semiconductor memory utilizing the data record identification portion and locates the corresponding record locator index associated with the requested data record. The apparatus then directly retrieves the data record from the storage medium using the record locator index located during the search of semiconductor memory.

In the preferred embodiment, the data records are received in CKD format and stored on an FBA formatted disk drive. The record identification portions and associated record locator indices are combined to form one record locator table stored in one or more blocks of the FBA formatted disk drive and also copied in the high speed semiconductor memory.

A method for retrieving one or more requested data records stored on a storage medium is disclosed utilizing a data record locator index stored in memory and includes the steps of receiving a plurality of data records, each record including at least a record identification portion and the data portion, and transferring and storing the data records to one or more storage mediums. The method also includes generating a plurality of record locator indices, each of which are associated with one of the plurality of data records and uniquely identify the location of the each of the plurality of data records stored on the storage medium. Also included are the steps of storing at least a plurality of record locator indices and the associated plurality of record identification portions in memory. In response to a request for access to one or more of the plurality of data records, the method includes searching the memory, locating one or more data record identification portions and associated record locator indices corresponding to the one or more requested data

records, and directly retrieving from the storage medium the requested data records as directed by the record locator indicie.

In one embodiment, the method of the present invention includes transforming and encoding CKD formatted data records onto one or more FBA disk drives. Also in the preferred embodiment, the step of storing the data record to one or more storage mediums includes storing the data to one or more directly addressable storage medium, the step of storing further including the steps of transforming and encoding at least the record identification portion of each of the data records, generating a plurality of record locator indices, and combining the transformed and encoded record locator indices and record identification portions, for forming a record locator table stored in a high speed semiconductor memory.
DRAWING DESCRIPTION:

BRIEF DESCRIPTION OF THE DRAWINGS

These, and other features and advantages of the present invention are described below in the following detailed description and accompanying drawings, in which:

FIG. 1 is a block diagram of the system for disk mapping and data retrieval according to the present invention;

FIG. 2 is a schematic representation of a CKD formatted data record;

FIG. 3 is a schematic representation of several blocks from a fixed block disk drive in which has been inserted the CKD formatted data transformed according to the method of the present invention;

FIG. 4 is a detailed schematic representation of a portion of the data identification and locator table of FIG. 3;

FIG. 5 is a detailed schematic representation of a portion of the device identification and locator table of FIG. 4;

FIG. 6 is a flowchart of the method for transforming CKD formatted data into fixed block data including a method for preparing a record identification and locator table; and

FIG. 7 is a flowchart illustrating the method for compressing the length of the record identification and locator table according to the present invention.

DETAILED DESCRIPTION:

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the present invention, the disk storage system 10, FIG. 1, for disk mapping and data retrieval includes one or more means for receiving write commands and data such as channel adapter boards 12a-12d. The channel adapter boards are adapted to receive disk read/write commands and data over a plurality of communication channels such as channels 14 from one or more host computers (not shown) over channels identified respectively as 1-8 in FIG. 1.

The channel adapter boards 12a-12d are connected to temporary or cache semiconductor memory storage unit 16 by means of bus 18. Bus 18 is also connected to one or more disk adapter boards 20 which read and write data to one or more disk drive units 22.

Each of the disk drive units 22 may include one or more disk drives, depending upon the user's requirements. Also included in the system is one or more uninterruptable power supply (UPS) 24.

In operation, one or more channel adapter boards 12a-12d receive write commands along with the accompanying data over one or more channels 14 from one or more host computers. In the preferred embodiment, the data is received in CKD format. In order to improve system performance, the disk storage system of the present invention does not wait for disk adapters 20 to locate and update the data on the appropriate disk drives but rather, the channel adapter boards store the data in CKD format in temporary semiconductor memory storage unit or cache 16.

In addition to storing the data that must be written to one or more disk drives 22, channel adapter boards 12a-12d store in the memory, an indication associated with each data record that must be written to disk, indicating to the disk adapters 20 that the associated data record stored in cache must be written to the disk drives.

A more detailed description of a disk storage system with write preservation utilizing a write pending indicator is described in U.S application Ser. No. 07/556,254 filed concurrently with the present application and incorporated herein by reference.

In one embodiment, the system and method for disk mapping and data retrieval includes mapping CKD formatted data onto fixed block disk drives. To facilitate understanding of the CKD to FBA data transformation a CKD record 30, FIG. 2 is shown and described below.

In order for a CKD disk drive to locate the first record on any given track, the disk drive read/write head must search the entire track until it encounters a position indicator called an address mark 32. Following a short gap 34 in the track, the first record 30 begins. The CKD record is divided into three fields or portions: the record identification portion, called the count, 36 followed by another gap, 37; the optional key portion 38; and the data portion 40.

The count portion of the data record uniquely identifies this record. The count is the portion of the record that a host system requesting access to a given record presents to the disk drive in order to enable the disk drive to search for and locate the record.

The count is comprised of 8 bytes of information. Bytes 0 and 1, as shown at 42, are used to designate the length of the data, while the third byte, 44, designates the length of the optional key field. The fourth byte 46, designates the record number on the track. The fifth and sixth bytes 49, and the seventh and eigth bytes 50-51, designate the head and cylinder numbers respectively, at which the record is located on the device. The second record 52, is located immediately following the end of the data portion 40 of the first record 30.

Thus, in accordance with the present invention, a portion of an FBA disk having CKD formatted data stored thereon is shown in FIG. 3 and includes record identification and locator table 58 including the 5 blocks labeled 60a-60e, for the tracks of the previous cylinder which is organized as described below.

The first data record 61 of the next CKD cylinder being emulated and located on the FBA drive begins in block, 62. If the data portion of the record is longer than the length of the second block 62, the data portion of the first record will be continued in the next block 64, and subsequent blocks as necessary to store the data portion of the first record. If the length of the first record 61 is equal to or smaller than block 62, any remaining unused portion of block 62 will not be used and instead, the data portion of record 2, 63, will begin in FBA disk drive block 64. This process will repeat itself until all of the blocks of a given cylinder being emulated have been copied. Thus, because the data portion of every record begins at the beginning of a block, (i.e. there is never more than one data record per block), once the system computes the address or block in which a requested data record resides, immediate access Is possible with little or no disk drive search time. Utilizing he record identification and locator table of the present invention, the system is able to compute the number of fixed length blocks that must be read to retrieve all the data of a given record, as illustrated herein below. Each record identification and locator table is subsequently loaded into the system memory to facilitate and greatly reduce data record searching and data retrieval time.

Shown in greater detail in FIG. 4, is a data record and identification table 70 according to the present invention for one device such as one disk drive including multiple cylinders. Each cylinder being emulated includes such a table on the drive itself, as well as a corresponding copy in the semiconductor cache memory.

Each device record identification and locator table includes a header portion 72 followed by one or more cylinder portions 74-78. In turn, each cylinder portion is comprised of a plurality of track portions 80.

Device header portion 72 of the record locator and identification table includes such information as shown in Table 1 below, including the length of the header, line 1; the starting address of the device scratch memory address, line 2; and the length of the device header including the scratch area, line 3. The header also includes one or more bytes for device flags, line 4.

TABLE 1

DEVICE ID TABLE HEADER BUFFER AND FLAG OFFSETS

```
 1. DV HEADER      SIZE $1000    LENGTH OF DV HEADER AT THE ID TABLE
 2. DV SCRATCH     OFFSET
                        DV HEADER
                              DV SCRATCH START ADDRESS
 3. DV HEADER LENGTH
                   SIZE $1000    LENGTH OF DV HEADER AT THE ID TABLE
                                 INCLUDING THE SCRATCH AREA
DV HEADER BUFFERS OFFSETS
 4. DV FLAGS       OFFSET
                        0             DV TABLE FLAGS
 5. DV STATISTICS OFFSET
                        4             STATISTICS/RESERVED BYTES
 6. DV READ TASK  OFFSET
                        $40           READ TASK (ONLY ONE)
 7. DV SENSE INFO OFFSET
                        $60           SENSE INFO FOR THIS DV
 8. DV TABLE SELECT BUFFER
                   OFFSET
                        $80 $40 BYTES
                                      SELECTION BUFFER FOR THE DEVICE
 9. RW COUNT BUFFER
                   OFFSET
                        $C0 8 BYTES R/W COUNT COMMAND DATA BUFFER
10. DV WR PEND FLAGS
                   OFFSET
                        $100
                            $140 BYTES
                                      WR PENDING BIT PER CYLINDER
11. DV WR PEND GROUPS
                   OFFSET
                        $240
                            $20 BYTES
                                      WR PENDING BIT FOR 8 CYLINDERS
12. DV FLAGS SELECT BUFFER
                   OFFSET
                        $280
                            $40 BYTES
                                      SELECTION BUFFER FOR UPDATES
13. DV FMT CHANGED FLAGS
                   OFFSET
                        $300
                            $140 BYTES
                                      FMT CHANGED BIT FOR CYLINDER
14. DV FMT CHANGED GROUPS
                   OFFSET
                        $440
                            $20 BYTES
                                      FMT CHANGED BIT FOR 8 CYLINDERS
15. DV TEMP BLK   OFFSET
                        $400
                            $200 BYTES
                                      TEMP BLK FOR RECOVERY
16. TEMP CYL ID SLOT
                   OFFSET
                        $600
                            $A00 BYTES
                                      TEMP ID FOR RECOVERY
```

Such flags include a write pendinq flag which is set if one or more records on the device are temporarily stored in cache memory awaiting writing and storing to the disk drive, as well as an in-cache bit indicating that at least one record on the device is located in cache memory to speed up access to the record, line 4. Other bytes of the device header provide various informational, operational, or statistical data to the system.

For example, the write pending group flags shown at line 11 include one bit indicating a write pending on any one record on any of the 64 preselected consecutive cylinders comprising a cylinder group. Similarly, each cylinder has a write pending flag bit in the device header as shown at line 10. The various write pending flags form a "pyramid" or hierarchy of write pending flags which the system may search when no access to records stored on disks are requested for handling write pending requests. Such a hierarchy structure allows the system to inquire level by level within the structure whether any records on the device; any records within a group of cylinders; any records on a given cylinder; any records on a track; and record by record, whether any write pending flags are set or whether any records are located in cache memory. Such information is useful when processing data such as writing data to disk after a power, failure as more fully described in U.S. patent application No. 07/586,254 filed concurrently herewith and incorporated herein by reference. The "last track" header is a header of a fictitious or non-existant track and serves to indicate that the record locator table was itself modified and must also be written to disk.

A more detailed description of the cylinder header portions 82a-82c of the device record identification and locator table 70 of FIG. 4 is shown in Table 2 wherein any given cylinder header includes such information as the length of the cylinder header, line 1; cylinder write pending flags, line 4; the physical address of the cylinder line 6; and the CRC error check byte of the cylinder, line 7.

TABLE 2

CYLINDER ID TABLE HEADER BUFFERS AND FLAGS OFFSETS	
1. CYL.sub.-- HEADER.sub.-- LENGTH SIZE $AO ID TABLE	LENGTH OF CYL HEADER AT
2. CYL.sub.-- FLAG OFFSET	
	0 CYL FLAGS
3. CYL.sub.-- FLAG.sub.-- AUX OFFSET	
	1 ADD ON TO THE ABOVE
4. CYL.sub.-- WR.sub.-- PEND.sub.-- FLAGS OFFSET	
	2 WR PENDING BIT PER TRACK
5. CYL.sub.-- STATISTICS OFFSET	
	4 STATISTICS/RESERVED BYTES
6. CYL.sub.-- PH.sub.-- ADD OFFSET	
	16 PH ADD OF CYL
7. CYL.sub.-- SLOT.sub.-- CRC OFFSET	
	23 CRC OF CYL

Each track entry in the record identification and locator table is shown in greater detail in FIG. 5 and comprises a track header portion 84 and a track body portion 86. The track header portion 84 includes information as shown in Table 3 below, including a track flag byte, line 1; record-count bytes, line 2,; the track CRC check byte, line 3; track compress patterns line 4; and cache address pointer, line 5.

The body 86, FIG. 5 of the track portion of the record identification and locator table includes a plurality of record flags 83, (line 6, Table 3,) beginning at byte 20 and record modifiers 85 (line 7, Table 3) beginning at byte 159 and extending sequentially backward as necessary or until a collision with the record flags 83 ocurrs.

TABLE 3

ID TABLE TRACK HEADER AND BODY OFFSETS

```
 1. TRACK.sub.-- FLAG
                  OFFSET
                       0  TRACK FLAGS
 2. .RECORD.sub.-- COUNT
                  OFFSET
                       1  NUMBER OF RECORDS AT THIS TRACK
 3. TRACK.sub.-- CRC
                  OFFSET
                       5  CRC BYTE FOR TRACK
 4. COMPRESS.sub.-- PATTERNS
                  OFFSET
                       6  TRACK COMPRESS PATTERNS
 5. CACHE.sub.-- TRACK.sub.-- POINTER
                  OFFSET
                       14 POINTER TO CACHE
 6. RECORD.sub.-- FLAGS
                  OFFSET  COMMON FLAG POINTER
 7. TRACK.sub.-- TABLE.sub.-- BODY
                  OFFSET  TRACK BODY
   (MODIFIER)
TRACK COMMON FLAG BITS
 8. DEFECTIVE     BIT  7  DEFECTIVE TRACK
 9. ALT           BIT  6  ALTERNATE TRACK
10. EX.sub.-- TRACK.sub.-- TABLE
                  BIT  5  EXTENDED TRACK TABLE SLOT
11. WRT.sub.-- PEND
                  BIT  4  WRITE PENDING IN TRACK
12. DIAG.sub.-- CYL
                  BIT  3  DIAGNOSTICS CYL (`CE`, `SA`)
13. NOT.sub.-- USED
                  BIT  2  NOT USED
14. INVALID.sub.-- ID
                  BIT  1  ID SLOT DEFECTIVE AND INVALID
15. IN.sub.-- CACHE
                  BIT  0  TRACK IN CACHE FLAG
RECORD FLAGS BITS
16. COMPRESS.sub.-- CODE
                  BITS 0-3
                          COMPRESS ALGO' FOR THIS
                          RECORD
17. KEY.sub.-- IN.sub.-- CACHE
                  BIT  4  KEY FIELD IN CACHE
18. DATA.sub.-- IN.sub.-- CACHE
                  BIT  5  DATA FIELD IN CACHE
19. KEY.sub.-- W.sub.-- PEND
                  BIT  6  KEY FIELD WRITE PENDING
20. DATA.sub.-- W.sub.-- PEND
                  BIT  7  DATA FIELD WRITE PENDING
```

The track flags shown on line 1 in table 3 are described in detail on lines 8-15 and includes such bits indicating a defective track bit, line 8; a write pending bit, line 11; and a track in cache bit, line 15. Similarly, the record flag bits of line 6 are shown in greater detail in lines 16-20 including bits comprising the compression algorithm for this record, line 16; key and data fields in cache, lines 17 and 18; and key field and data field write pending bits, lines 19 and 20.

The channel adapters 12a-12d , FIG. 1, receive data and read/write commands from one or more hosts over its respective channels. The data records are provided by the host in CKD format and are stored in cache memory 16 in CKD format. All records stored in cache whether temporarily while awaiting writing to disk, or records which have been read from the disk to be stored in cache for quicker access, are stored in CKD format. When the record is to be written to the disk drive, one of disk adapters 20 reads the data from cache memory over bus 18 and converts the CKD formatted data to the format of the present invention including a record identifier and locator

table all of which can stored in a plurality of fixed locks before outputting the data over the disk adapters' SCSI interface to one or more of disk drives 22.

The present method for mapping CKD formatted data into fixed block disk drives is, in part, based on the recognition that under usual conditions, a sequence of CKD formatted records will include the "R" portion of the count identifying the record number from among a number of sequentially numbered data records of the same length. Further, the records are generally stored on the same device cylinder and accessed by the same device head. Additionally, the key length will generally be zero or some predetermined generally constant number. Thus, the method for disk mapping 100, FIG. 6 of the present invention includes establishing the profile of an expected record, step 110. In the preferred embodiment, the expected record is established with the count CCHH code as the physical cylinder and head identification, as well as the key length (K.sub.1)=0, data length (D.sub.1)=8 and the "R" byte of the count assigned as record number (n)=0. Further, the record flags are set to 00.

During step 112, the system employing the method of the present invention obtains the first CKD formatted record and compares the CKD record with the previously established expected record step 114. At step 116, a determination is made as to whether or not the CKD formatted record including the "count" and record flags match those of the expected data record. If the CKD formatted record and the expected record match, the method proceeds to step 118 wherein the body of the track portion of the record identification and locator table previously discussed in conjunction with FIG. 5 and table 3 is built. Since the CKD formatted record matched the previously established expected data record, the record flag is set to 00 and no entry is made in the record modifier portion of the track ID cable. Subsequently, the "R" byte for the record number of the next expected data record is incremented by one, step 120, before returning to the step of obtaining the next CKD formatted data record at step 112.

If the results of the comparison at step 116 indicate that the CKD formatted record does not match the expected data record, the method proceeds to step 122 wherein a change format code (see Table 5) and record modifier, as required, are prepared. Next, the record format code and, if required, record modifier are inserted into the track identification table, step 124. If the track ID table is not full as determined at step 126, processing continues to step 128 wherein the current CKD count becomes the next expected count. Processing then returns to step 120 where the "R" byte is incremented by one before getting the next CKD record at step 112.

If, as indicated at step 126, the track identification table is full, meaning that the record flag portion of the ID table has collided with the record modifier portion of the ID table, the method of the instant invention will attempt to compress or shrink the body of the track ID table as shown in flowchart 130, FIG. 7. During the compression process of the instant invention, the system and method of the present invention attempt to define from one to eight data lengths which are repeated within this track. Such repeating data lengths are then classified as "patterns" and are thereafter referred to by a pattern "code" in the track header as shown on line 4 of Table 3, thus saving up to 2 bytes in the modifier portion of the track ID table for each repeated data length.

The method of the present invention first reads the ID table, step 132, searching for ID's with format code 03 for repeating values of data lengths, step 134. From those repeating values, the system and method of the present invention build a data length pattern table beginning with the data length that is most frequently repeated, and continuing on to find the seven most repeated data lengths and replaces the old 8 byte pattern with the new 8 byte pattern, step 136.

The method then proceeds to compare the data lengths of all the CKD records of the current track which have previously been read to determine whether or not any of the data lengths match the data patterns loaded in the pattern table, step 138. If any data lengths match the data patterns in the pattern table, the method proceeds to insert the data pattern code for the data length in a temporary ID table. Thus, the replaced record modifiers which previously contained the changed or modified data lengths are now unnecessary and eliminated, thus compressing or shrinking the size of the record identification and locator table and therefore allowing more room for the system to complete reading the CKD records for a given track. The system verifies at step 140, that the ID table was in fact compressed. If no ID table compression was achieved, the system reputs an error, step 142. If ID table compression was achieved, the method replaces the old ID table with the temporary ID table with compressed counts, step 144, before returning to step 120, FIG. 6.

Although this count compression routine somewhat reduces system performance, the

time to compute repeating data patterns and thus, to compress the "count" information in a record identification and locator table is minimal when compared to the tremendous savings of time which results from the ability to search the record locator table containing the count information in semiconductor memory instead of searching the disk drives for the requested record given the respective access times.

An example of a record identification and locator table for track 0 of a representative disk drive along with decoded information of each record is reproduced below as Table 4. This track identification and record locator table forms part of the device record identification and locator table as discussed previously in conjunction with FIG. 4. Line 2 of Table 4 corresponds to the track header portion 84, FIG. 5 of the track identification table also previously discussed in conjunction with table 3. The second byte of the header, the number "5" indicates that there are five records on this track.

TABLE 4

```
 1. TRACK NUMBER 0
 2. FLAGS/COUNT/H/W/R/S/PAT/CACHE PTR: 00 5 00 00 00 00 0000000000000000
00000000
 3. FLAGS
      00 01 03 03 01
 4. BODY:
      0000000000000000 0000000000000000 0000000000000000
      0000000000000000
 5.   0000000000000000 0000000000000000 0000000000000000
      0000000000000000
 6.   0000000000000000 0000000000000000 0000000000000000
      0000000000000000
 7.   0000000000000000 0000000000000000 0000000000000000
      000000000000000F
 8.   B0E050900418A0
                        RECORD FLAGS
 REC
    ID    KEY   DATA  WR  IN   NON PHYSICAL
                                      ADDRESS
 #  CCHHR LENGTH
                 LENGTH
                       PEND
                           CACHE
                                STD BLOCK  TRACK CACHE ADD
 9.
  00 0000000000
           00    0008  . . .
                             . . .
                                  00  00000000
                                          02E0
10.
  01 0000000001
           04    0018  . . .
                             . . .
                                  01  00000001
                                          04E0
  02 0000000002
           04    0090  . . .
                             . . .
                                  03  00000002
                                          0800
  03 0000000003
           04    0050  . . .
                             . . .
                                  03  00000003
                                          0B80
  04 0000000004
           00    0FB0  . . .
                             . . .
                                  01  00000004
```

Line 3 begins the record flag portion of the track identification table and is comprised of five record flags namely, flags: 00; 01; 03; 03; and 01. Each of the record flags is associated with a corresponding record, in ascending order. Thus, record flag 00 is associated with data record 0; record flag 01 is associated with data record 1; and record flag 03 is associated with data record 2 and so forth.

A representation of a record modifier portion of the track identification and locator table is shown at lines 4-8 of Table 4. As discussed in conjunction with FIG. 5, the record modifier portion of the track identification and record locator table is read backwards beginning with the byte, "A0" of line 8.

The track identification and record locator table of Table 4 may be further understood in conjunction with lines 9-13. As shown on line 9, which identifies record 0 of this track, the second, third and fourth columns comprise the original "count" information of the CKD record. It should be noted that this record matches the description of the "expected" record utilized in the example associated with the method of FIG. 6 since the first record on the track is record 0, the key length is 0, and the data length is 8 bytes. Thus, the record locator flag associated with that record, "00" is the first record flag byte encountered on line 3.

Proceeding to line 10, record number 1 on the track has a key length of 04 and a data length of 18 and thus, deviate from the previously established "expected" data record and thus is assigned a record flag of 01.

Various codes which comprise the record flags are reproduced in Table 5 below wherein as shown in line 1, the code 00 means no change to the previously established "expected" record. As shown in line 2 of the table, record flag format 01 indicates that the first byte of the record modifier is the change flag byte, indicating that every bit flagged with a "1" points to the byte in the record identifier that should be replaced by the following bytes in the record modifier. The order of the record identifier is shown in line 7 of table 5 and begins with the key length, followed by data length (high), data length (low) and the first byte of the cylinder.

TABLE 5

RECORD FORM AT CHANGE CODES	
1.	
ID FLAG FORMAT CODE 0:	NO CHANGE
2.	
ID FLAG FORMAT CODE 1:	1ST BYTE OF MODIFIER IS THE CHANGE FLAG BYTE
3.	EVERY BIT FLAGED POINTS TO BYTE IN THE
4.	ID THAT SHOULD BE REPLACED BY THE NEXT INFO BYTES.
5.	NUMBER OF EXTRA INFO BYTES IS THE NUMBER OF `1`S
6.	IN THE 1ST BYTE. THIS CODE IS USED IF WE CAN'T USE ANY OTHER CODE.
7.	:K.sub.L D.sub.LH D.sub.LL C CHHR
8.	
ID FLAG FORMAT CODE 2:	ONE BYTE INFO TO DL L + DL H = 2
9.	
ID FLAG FORMAT CODE 3:	ONE BYTE INFO TO DL L + DL H = 0
10.	
ID FLAG FORMAT CODE 4:	ONE BYTE INFO TO DL L DL H UNCHANGED
ID FLAG FORMAT CODE 5:	TWO BYTES INFO TO DL
ID FLAG FORMAT CODE 6:	

```
                        ONE BYTE INFOR TO DL L + DL H = 1
  ID FLAG FORMAT CODE 7:
                        ONE BYTE INFO TO DL L + DL H = PATT FROM ID TABLE
                        HEADER
  ID FLAG FORMAT CODE 8:
                        DL L = PATT #0 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE 9:
                        DL L = PATT #1 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE A:
                        DL L = PATT #2 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE B:
                        DL L = PATT #3 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE C:
                        DL L = PATT #4 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE D:
                        DL L = PATT #5 FROM ID TABLE HEADER + DL H = 0
20.
  ID FLAG FORMAT CODE E:
                        DL L = PATT #6 FROM ID TABLE HEADER + DL H = 0
  ID FLAG FORMAT CODE F:
                        DL L = PATT #7 FROM ID TABLE HEADER + DL H =
-------------------------------------------------------------------------
                        0
```

Thus, returning now to line 10 of table 4, the flag code 01 indicates that the first byte of the modifier namely, "A0" indicates the bits that are to be changed in the record identifier. Reading change byte A0 in conjunction with line 7 of Table 5 discloses that the successive bytes in the record modifier will modify the key length and data length (low) of the data record. The record modifier bytes in the track identification table modify the record identifier in reverse order as that shown in line 7 of Table 5 that is, from record number to key length. Thus, the second byte, "18" of the record modifier at line 8 of table 4 indicates that the previously expected data length is to be replaced with a data length (low) of "18", while the next byte of the record modifier, "04" is to replace the previously expected key length. It is in this manner that the system "reconstructs" the count portion of a CKD record from the "encoded" record identification and locator table.

Record number 2, line 11 of Table 4 also has a key length of "04" but the data length changes to "90". Thus, a flag of 03 is entered. The record flag of 03, as shown at line 9, Table 5, indicates that the next sequential byte of information in the record modifier is to be used as the data length (low) and the data length (high) will equal 0. Thus, the next consecutive entry of "90" in the record modifier portion of the track identification table body is accounted for.

Similarly, the next byte of the modifier portion of the track identification table is "50" which is the changed data length of record 3 read in conjunction with a record flag of "03" at line 12 of Table 4.

The final record flag "01" in the record flag portion of this track indicates that the next sequential byte namely, "E0" in the record modifier portion of the table is the changed flag byte pointing to the bytes in the record identifier that are to be changed or modified by the subsequent bytes in the record modifier portion of the table. Code E0 indicates that the key length, data length (high) and data length (low) are to be changed by the three bytes which follow as indicated by line 7, table 5. Thus, byte "B0" of the record modifier is used as the data length (low); byte "0F" is used as the data length (high) byte, and byte 00 modifies the former key length entry.

The building of a record identification and locator table in accordance with the present invention greatly reduces the amount of fixed block disk space required to store the "count" portion of a CKD formatted data record.

An additional example of a track level record identification and locator table is reproduced in table 6 below and is useful in showing an entry in the data pattern table previously described in conjunction with FIG. 7. Table 6 is a representation of a track identification table for an exemplary

TABLE 6

```
 1. TRACK NUMBER D00
 2. FLAGS/COUNT/H/W/R/S/PAT/CACHE PTR: 11 81 00 00 00 C7 3E14181500FB9024
03FDE000
 3. FLAGS
      00A320 28 202020XX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXX
 4.   XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXX
 5.   XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XX
 6. BODY:
      XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXXXX
 7.   XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
      XXXXXXXXXXXXXX28
                      RECORD FLAGS
  REC
     ID    KEY   DATA  WR  IN   NON PHYSICAL
                                        ADDRESS
  #  CCHHR LENGTH
                 LENGTH
                       PEND
                           CACHE
                                STD BLOCK  TRACK CACHE  ADD
 8.
  00 00D0000000
           00    0008  . . .
                       . . .
                                0   00047DB0
                                        02E0
 9.
  01 00D0000001
           00    0028  D.  D.   3   00047DB1
                                        04E0  03FDE118
10.
  02 00D0000002
           00    0028  . . .
                       D.   0   00047DB2
                                        0700  03FD3150
  03 00D0000003
           00    003E  . . .
                       D.   8   00047DB3
                                        0920  03FDE188
  04 00D0000004
           00    003E  . . .
                       D.   0   00047DB4
                                        0B60  03FDE1D0
  05 00D0000005
           00    003E  . . .
                       D.   0   00047DB5
                                        0DA0  03FDE218
  06 00D0000006
           00    003E  . . .
                       D.   0   00047DB6
                                        0FE0  03FDE260
```

On line 2 of table 6, the track "header" information is presented including the first byte "11" indicating that on this track, there is at least one record which is in cache, and at least one record which has a write pending, as previously explained in conjunction with Table 3. The second byte of the track header, "81" indicates there are 81 records in this track, while byte 5, "C7" is the CRC byte for this track. The next byte of the header, "3E" is the first byte of the data pattern table which extends for 8 bytes ending with "24". In this example, bytes 1-7 of the pattern table are not used, but are merely shown for illustrative purposes only. The

last four bytes of the ck header, "03 FD E0 00" is th cache beginning memory address at which any records from this track which are stored in cache are located.

Of particular interest in Table 6 is record 03 located at line 11. Since the data length, "3E" of record 3 is a deviation from the previously established data length "28", a record flag of other than 00 is expected, and thus the record flag "08" is entered. As can be compared from line 14 of the record flag codes in Table 5, record flag code "08" indicates that the data length (low) of this record identifier is to be loaded with pattern 0, the first pattern from the identification table header and thus, the "3E" pattern from line 2 of Table 6 is used as the data length for record number 3 when the system reconstructs the data record. The record flag, "28" which is shown and underlined on line 3 of table 6 also incidates that the data of this record is stored in cache. The cache address ascertained by adding up the cache memory starting address (line 2) contained in the header of the track identification table along with the length of any intervening data or key information stored in cache.

Modifications and substitutions of the present invention by one of ordinary skill in the art are considered to be within the scope of the present inventio, which is not to be limited except by the claims which follow.

CLAIMS:

We claim:

1. Apparatus for retrieving at least one requested data record stored on a storage medium comprising:

means for receiving a plurality of data records, each of said data records including at least a record identification portion and a data portion;

means, responsive to said means for receiving, for transferring and storing said plurality of data records on at least one of said storage mediums;

means, responsive to said means for transferring and storing, for generating a corresponding plurality of recording locator indices, each of said corresponding plurality of record locator indices associated with one of said plurality of data records and a corresponding recording identification portion, for uniquely identifying the location of each of said plurality of data records stored on said at least one of said storage mediums;

memory storage means, for storing at least said plurality of record locator indices and the associated record identification portions in one record locator table;

means for requesting access to one or more of said plurality of data records, and for providing the data identification portion corresponding to said at least one requested data record;

means, responsive to said means for requesting access, for searching said record locator table stored in said memory storage means, for locating said data record identification portion and associated one or more record locator indices corresponding to said at least one requested data record; and

record retrieval means, responsive to said means for searching, for directly retrieving from said at least one storage medium said at least one requested data record as directed by said associated record locator indices.

2. The system of claim 1 wherein said record retrieval means and said means for transferring and storing retrieves and stores at least one data record in said memory storage means; and

wherein at least one of said record locator indices further includes means for indicating that the at least one data record associated with said at least one of said record locator indices is stored in said memory storage means.

3. The system of claim 2 wherein each of said record locator indicates further includes a pointer to the memory address of the data record stored in said memory storage means;

4. The system of claim 2 wherein each of said record locator indices includes means for indicating that the associated data record is stored in said memory storage

means, and is awaiting writing to one or more of said storage mediums.

5. The system of claim 1 wherein each of said record locator indices and associated record identification portions are combined to form said one record locator table stored in said memory storage means.

6. The system of claim 5 wherein said means for generating said record locator indices includes means for reducing the length of each of said record identification portions prior to storing said record identification portion and said corresponding record locator indices in said record locator table.

7. The system of claim 5 wherein said means for generating includes means for reducing the length of both said record locator indices and record identification portions prior to storing said record identification portion and record locator indices in said record locator table.

8. The system of claim 7 wherein said means for reducing transforms and encodes each of said record locator indicies and record identification portions, for reducing the length of both said record locator indices and record identification portions prior to storing in said record locator table.

9. The system of claim 1 wherein said record retrieval means directly retrieves the one or more requested data records from said one or more storage mediums with no intervening search of said one or more storage mediums.

10. The system of claim 1 wherein said FBA formatted storage medium includes a directly addressable FBA formatted storage medium comprising directly addressable record storage locations.

11. The system of claim 1 wherein said FBA formatted storage medium includes a fixed block architecture (FBA) formatted disk drive.

12. The system of claim 10 wherein said directly addressable storage medium includes semiconductor memory.

13. The system of claim 10 wherein said directly addressable storage medium includes one or more optical disks.

14. The system of claim 10 wherein said directly addressable storage medium includes a CD ROM disk.

15. Apparatus for transforming and mapping CKD formatted data records onto fixed block disk drives, and for retrieving one or more requested data records stored on a fixed block disk drive utilizing a data record locator index stored in memory, comprising:

means for receiving a plurality of CKD formatted data records, each of said data records including at least a record identification portion and a data portion;

means, responsive to said means for receiving, for transferring and storing said plurality of data records on one or more fixed block disk drives;

means, responsive to said means for transferring and storing, for generating a plurality of record locator indices, each of said plurality of record locator indicies associated with one of said plurality of data records, for uniquely identifying the location of each of said plurality of data records stored on said one or more fixed block disk drives, also including means for transforming and encoding each of said plurality of record locator indicies and record identification portions, for reducing the length of each of said record identification portions and record locator indicies;

means, responsive to said means for generating, for combining said transformed and encoded record locator indices and record identification portions, for forming a record locator table;

memory storage means, for storing said combined record locator table;

means for requesting access to one or more of said plurality of CKD formatted data records, and for providing one or more data identification portions corresponding to said one or more requested data records;

means, responsive to said means for requesting access to one or more of said

plurality of data record[illegible] for searching said record locator table stored in said memory storage means, for locating said one or more data record identification portions and associated record locator indices corresponding to said one or more requested data records; and

record retrieval means, responsive to said means for searching, for directly retrieving from said one or more fixed block disk drives, said one or more requested data records as directed by said one or more record locator indices.

16. A method for transforming and encoding CKD formatted data onto one or more fixed block architecture (FBA) disk drives, and for retrieving one or more requested data records stored on one or more of said fixed block architecture disk drives utilizing a data record locator index stored in memory, comprising the steps of:

receiving a plurality of CKD formatted data records, each of said CKD formatted data records including at least a record identification portion and a data portion;

storing to one or more directly addressable FBA formatted storage mediums, said plurality of data records, said step of storing including:

transforming and encoding at least said record identification portion of each of said plurality of data records from a CKD format to an FBA format;

generating a plurality of record locator indices; and

combining said transformed and encoded record locator indices and record identification portions, for forming a record locator table, each of said plurality of record locator indices corresponding to one of said plurality of data records, for uniquely identifying the location of each of said plurality of data records stored on said one or more FBA formatted directly addressable storage mediums;

storing said combined record locator table in memory;

searching said record locator table stored in memory, for locating said one or more data record identification portions and associated record locator indices corresponding to one or more requested data records; and

directly retrieving from said one or more directly addressable storage mediums, said one or more requested data records as directed by said one or more record locator indices.

17. Apparatus for receiving one or more requested data records storage on a storage medium utilizing a data record locator index stored in memory, comprising:

means for receiving a plurality of data records, each of said data records including at least a record identification portion and a data portion;

means, responsive to said means for receiving, for transferring and storing said plurality of data records on at least one of said storage mediums;

means, responsive to said means for transferring and storing, for generating a plurality of record locator indices, each of said plurality of record locator indices associated with one of said plurality of data records and a corresponding record identification portion, and for uniquely identifying the location of each of said plurality of data records stored on said at least one of said storage mediums, said means for generating including means for transforming and encoding each of said record locator indices and record identification portions, for reducing the length of both said record locator indices and said record identification portions, and for combining said reduced length record identification portions with said corresponding reduced length record locator indices;

memory storage means, for storing at least said plurality of reduced length and combined record locator indices and corresponding record identification portions to form one record locator table;

means for requesting access to one or more of said plurality of data records, and for providing one or more data identification portions corresponding to said one or more requested data records;

means, responsive to said means for requesting access, for searching said record locator table stored in said memory storage means, for locating said one or more data record identification portions and associated record locator indices

corresponding to said one or more requested data records; and

record retrieval means, responsive to said means for searching, for directly retrieving from one or more of said storage mediums said one or more requested data records as directed by said one or more record locator indices.

18. The system of claim 17 wherein said plurality of data records and record identification portions are received in CKD format, and said plurality of data records are stored on at least said storage medium having an FBA format; and

wherein said means for reducing transforms and encodes said record identification portions from said CKD format to said FBA format.

19. Apparatus for retrieving at least one requested data record stored on a data storage medium, comprising:

a data record receiver, for receiving a plurality of data records, each of said data records including at least a record identification portion and a data portion;

a data record storer, responsive to said data record receiver, for transferring and storing said plurality of data records on at least one of said data storage medium;

a record locator index generator, responsive to said data record storer, for generating a corresponding plurality of record locator indices, each of said corresponding plurality of record locator indices associated with one of said plurality of data records and the corresponding record identification portion, for uniquely identifying the location of each of said plurality of data records stored on said at least one of said storage mediums;

memory storage, for storing at least said plurality of record locator indices and the associated record identification portions in one record locator table;

a data record access requestor, for requesting access to at least one of said plurality of data records, and for providing the data identification portion corresponding to said at least one requested data record;

a record locator table searcher, responsive to said data record access requestor, for searching said record locator table stored in said memory storage, for locating the data record identification portion and associated record locator indices corresponding to said at least one requested data record; and

a recording retriever, responsive to said record locator table searcher, for directly retrieving from said at least one storage medium, said at least one requested data record as directed by said associated at least one record locator indices.

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L10: Entry 11 of 14 File: USPT Dec 1, 1998

US-PAT-NO: 5845077
DOCUMENT-IDENTIFIER: US 5845077 A

TITLE: Method and system for identifying and obtaining computer software from a remote computer

DATE-ISSUED: December 1, 1998

INVENTOR-INFORMATION:

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APPL-NO: 8/ 562929 [PALM]
DATE FILED: November 27, 1995

INT-CL: [6] G06 F 7/00

US-CL-ISSUED: 395/200.51; 364/221, 364/221.7, 364/222.81, 364/259, 395/712, 395/200.09
US-CL-CURRENT: 709/221; 717/173

FIELD-OF-SEARCH: 395/712, 395/200.09, 395/200.51, 395/232, 364/479.01, 380/4

PRIOR-ART-DISCLOSED:

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Search Selected | Search ALL

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ART-UNIT: 272
PRIMARY-EXAMINER: Swann; Tod R.
ASSISTANT-EXAMINER: Tzeng; Fred F.
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ABSTRACT:

Creators of computer software provide the most up-to-date versions of their computer software on an update service. A user who has purchased computer software calls the update service on a periodic basis. The update service automatically inventories the user computer to determine what computer software may be out-of-date, and/or need maintenance updates. If so desired by the user, the update service computer automatically downloads and installs computer software to the user computer. By making periodic calls to the update service, the user always has the most up-to-date computer software immediately available. The update service may also alert the user to new products (i.e. including new help files, etc.), and new and enhanced versions of existing products which can be purchased electronically by a user from the update service.

24 Claims, 6 Drawing figures

End of Result Set

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L6: Entry 4 of 4 File: USPT Apr 21, 1998

US-PAT-NO: 5742792
DOCUMENT-IDENTIFIER: US 5742792 A

TITLE: Remote data mirroring

DATE-ISSUED: April 21, 1998

INVENTOR-INFORMATION:

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APPL-NO: 8/ 654511 [PALM]
DATE FILED: May 28, 1996

PARENT-CASE:
RELATED APPLICATION This application is a continuation-in-part of U.S. patent application Ser. No. 08/052,039 filed Apr. 23, 1993, entitled REMOTE DATA MIRRORING (U.S. Pat. No. 5,544,347 issued Aug. 6, 1996), which is fully incorporated herein by reference.

INT-CL: [6] G06 F 12/16

US-CL-ISSUED: 395/489; 395/182.03, 395/182.04, 395/488, 395/492, 395/821, 371/10.1, 371/21.1, 371/40.1, 364/DIG.1
US-CL-CURRENT: 711/162; 710/1, 711/161, 711/165, 714/5, 714/6, 714/710, 714/718, 714/763

FIELD-OF-SEARCH: 395/182.03, 395/182.04, 395/488, 395/489, 395/492, 395/821, 371/10.1, 371/21.1, 371/40.1

PRIOR-ART-DISCLOSED:

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ART-UNIT: 238
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ATTY-AGENT-FIRM: Arnold, White & Durkee

ABSTRACT:

Two data storage systems are interconnected by a data link for remote mirroring of data. Each volume of data is configured as local, primary in a remotely mirrored volume pair, or secondary in a remotely mirrored volume pair. Normally, a host computer directly accesses either a local or a primary volume, and data written to a primary volume is automatically sent over the link to a corresponding secondary volume. Each remotely mirrored volume pair can operate in a selected synchronization mode including synchronous, semi-synchronous, adaptive copy - remote write pending, and adaptive copy - disk. Direct write access to a secondary volume is denied if a "sync required" attribute is set for the volume and the volume is not synchronized. If a "volume domino" mode is enabled for a remotely mirrored volume pair, access to a volume of the pair is denied when the other volume is inaccessible. In a "links domino" mode, access to all remotely mirrored volumes is denied when remote mirroring is disrupted by an all-links failure. The domino modes can be used to initiate application-based recovery, for example, recovering a secondary data file using a secondary log file. In an active migration mode, host processing of a primary volume is concurrent with migration to a secondary volume. In an overwrite cache mode, remote write-pending data in cache can be overwritten. Write data for an entire host channel command word chain is bundled in one link transmission.

38 Claims, 24 Drawing figures

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NAME	CITY	STATE	ZIP CODE	COUNTRY
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U.S. PATENT DOCUMENTS

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	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	4866611	September 1989	Cree et al.	364/705.08
☐	5093787	March 1992	Simmons	705/33
☐	5101492	March 1992	Schultz et al.	395/575
☐	5185884	February 1993	Martin et al.	395/575
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☐	5235601	August 1993	Stallmo et al.	371/40.1
☐	5263154	November 1993	Eastridge et al.	395/575
☐	5317731	May 1994	Dias et al.	395/600
☐	5357509	October 1994	Ohizumi	371/10.1
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☐	5434994	July 1995	Shaheen et al.	707/201
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☐	5740397	April 1998	Levy	711/114

ART-UNIT: 277
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ABSTRACT:

A data network with a remote data facility for providing redundant data storage and for enabling concurrent access to the data for multiple purposes. A local data processing system with a data facility stores a data base and processes transactions or other priority applications. A second system, physically separated from the first system includes the remote data facility that normally mirrors the data in the first system. In an independent access operating mode, the second system is enabled to operate on the data within its data facility concurrently with, but independently of, the operation of the first system. On completion of the independent operation, the second system reconnects with and synchronizes with the first system thereby to reestablish the mirroring operation of the second system.

27 Claims, 8 Drawing figures